Maize – Morocco – Dr. Aziz – 2025

Overview

- Researcher: Mrs. Imane R'bibe
- Examiner: Prof. Aziz Abouabdillah
- Research Institute: ENA of Meknes (French: L'École Nationale d'Agriculture de Meknès - The National School of Agriculture of Meknes), Morocco
- Governing Institute: Ministry of Agriculture, Maritime Fisheries, Rural Development and Water and Forests of Morocco
- Goal of Study: to test and measure the efficacy of Kyminasi® Crop Booster™ (KCB) to save water in the cultivation of fodder maize (corn) when grown under greenhouse cover in Morocco
- Report Date: September 26, 2025

Time

- Seeding Date: March 22, 2024
- Harvesting Date: July 22, 2024

Location

- Place: National School of Agriculture – ENA, Meknes
- Country: Morocco
- Coordinates: 33°50'36.1"N 5°28'38.7"W
- Elevation: 2074 ft (632 m)
- Trial Environment: Greenhouse



Species

- Crop: Maize
- Variety: Dracma
- Density: 1 plant / pot

Soil

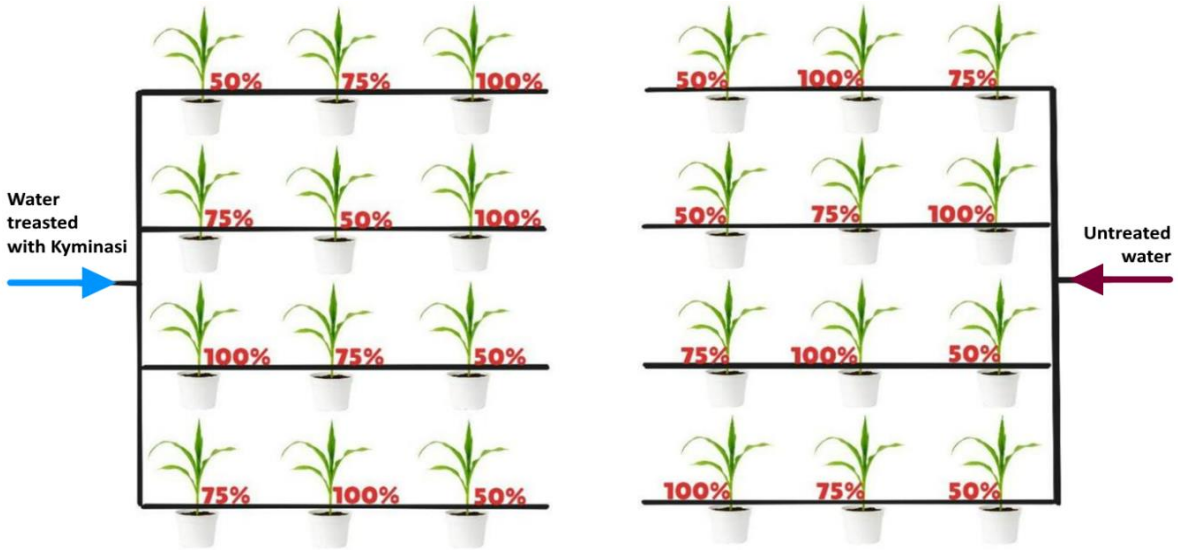
- Texture: Clayey
- HCC[1]: 42.5%
- HPFP[2]: 27.0%

Irrigation

- Type: Drip, G-to-G[3]
- Mode: 4 drippers / pot
- Dripper flow rate: 1.2 l/h
- Kyminasi technology: integrated upstream of the system

Trial Setup

- Number of treatments: 6 (water 50%-75%-100% with KCB, water 50%-75%-100% without KCB)
- Number of repetitions per treatment: 4
- Experimental unit: 2 pots
- Number of pots: 48
- Design: Split plot (order randomized as shown in the diagram below)

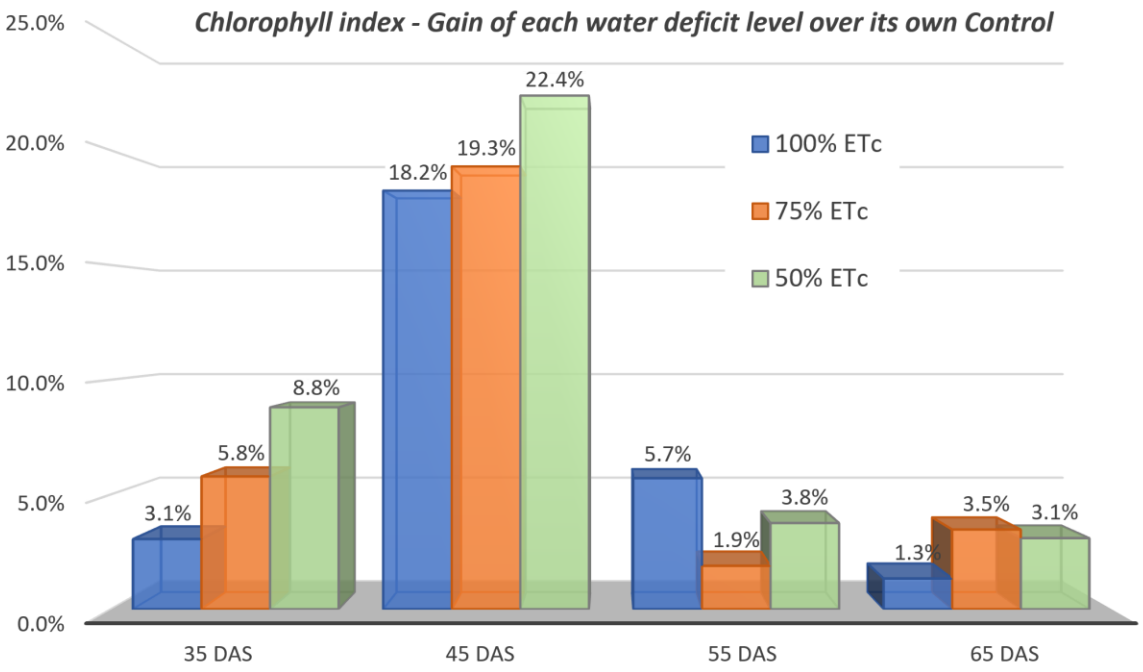


[1] HCC: Hydraulic Conductivity Curve
[2] HPFP: permanent wilting point humidity (French: Humidité de Point de Flétrissement Permanente)
[3] Ground-to-Ground or gravity-to-ground, a system that uses gravity and is installed on the ground or just below the surface.

Results

Vegetative Growth Parameters

- Total number of leaves (statistical average): 7.5% more leaves with KCB between 35 DAS and 75 DAS, and 6% more leaves at 75 DAS with KCB. The average number of leaves went down by only 1% in the water reduction level of 25% (75% ETc), indicating good drought tolerance at moderate watering reduction.
- The statistical average of collar diameter: 11% larger with KCB between 35 DAS and 75 DAS, and 9.6% more leaves at 75 DAS with KCB. The average number of leaves went down by 3.5% in the water reduction level of 25% (75% ETc), again indicating good drought tolerance at moderate watering reduction.
- Plant height (statistical average): plants were 2.7% taller with KCB between 35 DAS and 75 DAS, and 11.5% more leaves at 75 DAS with KCB.
- Chlorophyll of the maize plants treated with KCB was higher than their corresponding Control in all water deficit levels. As shown in the diagram below, the highest gain was 22.4% higher chlorophyll with 50% deficit (50% ETc) at 45 DAS.



- Leaf Relative Water Content (LRCW) was higher at 83 DAS with KCB in all water deficit levels:
  - 50% water deficit (50% ETc): LRCW was 44% higher than Control (SK),
  - 25% water deficit (75% ETc): LRCW was 16.5% higher than Control,
  - 0% water deficit (100% ETc): LRCW was 16% higher than Control.

- At 50% water deficit (50% ETc), the Water Usage Efficiency (WUE) was 23% higher than 100% ETc, and 61% higher than 100% ETc.
- The total average WUE with Kyminasi was 24% higher than Control (SK).
- Proline content was 15% lower with Kyminasi, indicating better stress resistance, especially drought resilience.
- In each water deficit level, the treated plants demonstrated shorter time to achieve panicle appearance and silk production as compared to their Control counterparts.
- Anthesis-Silking Intervals (ASI's) were significantly shorter with KCB in all water deficit levels, indicating successful pollination (for higher yields) as well as greater drought resilience:
    - At 50% water deficit (50% ETc) ASI was 43% shorter than Control,
    - At 25% water deficit (75% ETc): ASI was 54% shorter than Control,
    - At 0% water deficit (100% ETc): ASI was 47% shorter than Control.

Yield Parameters

- Total FRESH weight (statistical average) was 8.3% higher with KCB, with 4.1% loss of fresh weight at 25% water deficit (75% ETc) as compared to 0% deficit.
- Total DRY weight (statistical average) was 23% higher with KCB, with only 2.2% loss of dry weight at 25% water deficit (75% ETc) as compared to 0% deficit.

Conclusions

Based on the findings, the researchers concluded the following:

- Using Kyminasi technology, with severe water deficit (25% ETc) there was a marked negative impact on the growth, physiology and productivity of fodder maize.
- Using Kyminasi technology, with moderate water deficit (75% ETc) a relatively satisfactory drought tolerance of fodder maize was demonstrated.
- Kyminasi technology caused an improved stress tolerance and improved plant performance.
- When Kyminasi technology was combined with a 25% reduction in watering (75% ETc) the researchers found an optimal balance between water efficiency and productivity of fodder maize plants.

Attachments

- ENA Report titled "Evaluation of the combined effect of deficit irrigation and Kyminasi technology on the growth, development and production of fodder maize (Zea mays L.) grown under greenhouse cover"
- The French version of same is available on the Harvest Harmonics' website.

Definitions

*: there is a significant effect

AK: with Kyminasi (French: “Avec Kyminasi”)

ASI: Anthesis-Silking Interval

D.A.S, DAS: Days After Seeding

DNM: Readily Available Water

ENA: in French, École Nationale d'Agriculture – National School of Agriculture, in Meknès, Morocco

ETc: Crop Evapotranspiration (French: ÉvapoTranspiration des cultures)– the amount of water a crop needs

ETo: The reference evapotranspiration, which is the evapotranspiration of a reference crop

EWUE: Economical Water Use Efficiency

f: crop-specific coefficient

FAO 56: the world standard method for computing water requirement of irrigated crops from limited data [Allen et al, 1988, https://appgeodb.nancy.inra.fr/biljou/pdf/Allen_FAO1998.pdf]

FC: Field Capacity

GDU: Growing Degree units

HCC: Hydraulic Conductivity Curve

Hcf: field capacity of Humidity

HPFP: permanent wilting point humidity (French: Humidité de Point de Flétrissement Permanente)

Kc: The crop coefficient, which is a value that takes into account the crop's attributes and how it's managed

Kyminasi = Kyminasi® Crop Booster™

LRCW: Leaf Relative Water Content

MAD: Moroccan Dirham

n.s: no significant effect

NB: number

NSE: No Significant Effect

Phs is Psh

Psh (Phs): % of soil humidity

PWP: Permanent Wilting Point

Rd: Root depth

RFU: readily usable reserve (in this study, in millimeters of water)

RFU: water reserve easily used by water

SK: without Kyminasi (French: “Sans Kyminasi”)

Stades: stages

T (Tmin, Tmax): temperature (in this study, in degrees Celsius)

WUE: Water Use Efficiency